Vol. 1, No. 1, pp.25–35., 2024

JERES

JaNIC Journal of Educational Research, Evaluation and Supervision
https://journal.jannatunnaimlampung.com/index.php/JERES/index

Development of HOTS Ethnomathematics Questions Based on Islamic Values to Enhance Students' Positive Psychology

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Article Info

Article history:

Received:
8 December, 2024

Accepted:
24 December 2024

Published:
30 December, 2024

Keywords:

ethnomathematics;
islamic values;
positive psychology;
HOTS questions

ABSTRACT

HOTS questions must be implemented in learning because they refer to cognitive abilities and help students get used to analyzing, evaluating, and synthesizing information. Ethnomathematics HOTS questions still need to be applied in school learning. This study aims to develop HOTS math questions that connect culture with Islamic values, using the traditional Acehnese house as an example of a culture that can be linked with mathematics. The research and development process consists of three stages: analysis, design, and development. This development research results in a product in the form of valid HOTS ethnomathematics questions based on Islamic values that enhance students' positive psychology.

INTRODUCTION

One of the roles of mathematics is to prepare students to use mathematical concepts and thinking in daily life and to study various fields of science. Recognizing the importance of mathematics in everyday life and the workplace, students must master mathematics at all levels of education, and there is a need to improve the quality of mathematics learning(Pasinda et al., 2022).

The Indonesian government has made significant efforts to enhance the credibility of younger generations, including implementing HOTS (Higher Order Thinking Skills)-based learning and assessment (Pratiwi et al., 2023). Developing and testing higher-order thinking skills in students, especially at the secondary school level, is essential as a reference for preparing assessment tools (Sabani et al., 2022). Higher-order thinking skills (HOTS) are cognitive abilities that enable students to connect and transfer knowledge across concepts, process information, solve problems, and analyze creative, innovative, and critical ideas. HOTS involves deeper levels of thinking beyond mere recall or memorization and focuses on analysis, evaluation, and synthesis of information (Tarina, 2021). HOTS is a deep thinking process to process information, handle complex problems, and analyze, evaluate, and create (Yulitya et al., 2021). Implementing HOTS in learning is crucial because it trains cognitive abilities, enabling students to analyze, evaluate, and synthesize information effectively.

Students with high numeracy skills who solve HOTS-based mathematical literacy problems can achieve all indicators. Those with moderate numeracy skills may need to meet reasoning and justification indicators (Nuringtyas & Setyaningsih, 2023). Students with high capabilities can fulfill all HOTS indicators (analyzing, evaluating, and creating), while students with moderate skills may only reach analyzing and evaluating indicators. Low-ability students

How to cite Loviana, S., & Rosidah, A. (2024). Development of HOTS Ethnomathematics Questions Based on Islamic Values to Enhance Students' Positive Psychology. *JaNIC Journal of Educational Research, Evaluation and Supervision*, 1(1), 25–35.

may only achieve the analyzing indicator (Hasyim & Andreina, 2019). HOTS-based mathematical literacy questions can be completed effectively by students with high numeracy skills and overall high abilities.

Interviews with mathematics teachers reveal that they still need to prepare mathematics materials using HOTS assessments. Teachers need more motivation to develop HOTS questions and have limited information about constructing such questions. Similarly, students reported having never worked on HOTS questions, as teachers typically provide routine problems. (Yuliantaningrum & Sunarti, 2020) In schools, questions tend to focus more on measuring students' recall abilities, which limits the development of higher-order thinking skills (HOTS). However, many mathematics competencies and standards could be designed to train students' HOTS. (Febrianti et al., 2021) HOTS-based questions involve analysis and evaluation, fostering critical and creative thinking and problem-solving skills. (Wicaksono, 2021) HOTS, representing the highest levels of cognitive hierarchy in Bloom's Taxonomy, does not rely on recall, repetition, or rule-following but emphasizes analysis, evaluation, and creation.

As a critical thinking process in mathematics learning, HOTS helps shape students to think logically and reflectively and make independent decisions (Yazidah et al., 2020). Teachers must be motivated and well-informed about HOTS assessments to creatively and skillfully develop HOTS-based questions (Widana, 2017). Therefore, teachers need to be motivated and provided with sufficient information to implement HOTS assessments in learning, as this enables students to think logically and reflectively and make independent decisions.

Ethnomathematics-based story problems are mathematical problems that incorporate cultural or ethical values. Solving such problems requires higher-order thinking to tackle them. One aspect of higher-order thinking in mathematics learning is creative thinking (Pertiwi dkk., 2023). Culture and mathematics can be integrated into evaluation tools during the learning process. Linking evaluation with culture enhances students' knowledge of culture and real-life issues (Ulya & Rahayu, 2020). Ethnomathematics-based learning introduces mathematical and cultural elements and reminds students of the importance of preserving culture (Maidiyah dkk., 2021). Thus, story problems incorporating cultural elements in mathematics learning can serve as evaluation tools, providing students with knowledge about culture and real-life issues.

This research introduces a novel approach by developing HOTS mathematics problems linked to culture and Islamic values, using the Acehnese traditional house (Rumoh Aceh) as an example. This house was selected for its environmentally adaptive construction, Islamic elements, and alignment with green, sustainable building principles. (Kevin et al., 2021) Rumoh Aceh incorporates religious and cultural values in its design, ensuring it evolves while retaining Islamic principles. (Dhuhri, 2018) Rumoh Aceh is constructed with patterns, shapes, and designs embody the Acehnese people's piety and religiosity. It continues to evolve and adapt to align with contemporary culture while preserving its Islamic characteristics.

Positive psychology theories were incorporated into the learning process, creating enjoyment and fostering a " flow state." Flow is a positive emotion associated with happiness and engagement (Takiuddin, 2023). Positive psychology emphasizes mental health and highlights the positive strengths within individuals (Nihayah et al., 2021). It is the scientific study of individuals and communities thriving by developing positive potential to achieve well-being (Hude, 2020). Rumoh Aceh is constructed with patterns, shapes, and designs that embody the Acehnese people's piety and religiosity. It continues to evolve and adapt to align with contemporary culture while preserving its Islamic characteristics.

Positive psychology is a scientific study related to mental health, focusing on positive emotions such as happiness and aiming to achieve well-being. HOTS assessments should integrate cultural elements to enhance logical and reflective thinking and foster independent

decision-making, analysis, evaluation, and synthesis of information. Previous research primarily developed HOTS questions targeting specific skills, while this study uniquely focuses on developing HOTS ethnomathematics problems rooted in Islamic values. (Kristanto & Setiawan, 2020) Examples include integrating rural contexts and algebra. (Wulandari et al., 2020) developing HOTS questions in algebra material for middle school students with validity, practicality, and effectiveness categories. (Masitoh & Aedi, 2020) The development of HOTS assessment instruments in mathematics for 7th-grade junior high school students is considered valid, with a moderate average difficulty level. The instrument has good discrimination power, indicating that it is suitable for arithmetic, linear equations and inequalities, geometry, and transformations (Budiman & Jailani, 2014). The assessment instrument designed to measure HOTS abilities in mathematics for 8th-grade students in the first semester has been validated and reliable, with a moderate difficulty level and good discriminatory power. Therefore, this study aims to develop HOTS-based ethnomathematics questions in the form of written responses, linking the Acehnese culture, specifically the Rumoh Aceh, to the positive psychology of students.

METHODS

This study uses research and development (R&D) methodology to create and produce specific products while testing their practicality and effectiveness in real educational contexts. The development method employed is the ADDIE model, which focuses on developing a Two-Tier Test Instrument based on higher-order thinking Skills (HOTS) for middle school students learning geometry. The development research phases include analysis, design, and development, conducted from October to December 2024. The subjects of the study were 40 students who had already studied the geometry material. Data collection techniques used include questionnaires, documentation, and tests. This is descriptive research with a qualitative and quantitative analysis approach and a documentation study, gathering data from written sources related to the research problem.

This study is focused on developing assessment questions, which includes steps such as preparing the specifications for the questions, writing and reviewing test items in alignment with essential competencies and indicators for geometry, conducting pilot tests, analyzing test items, and revising the questions.s.

RESULTS AND DISCUSSION

The development of HOTS questions is linked to geometry material and Indonesian culture, incorporating Islamic values. The chosen cultural element is the traditional Aceh house, or Rumoh Aceh, selected because its architecture embodies Islamic values. The design of Rumoh Aceh incorporates mathematical principles that can be used in teaching mathematics.

The validators included experts in the field, namely subject matter validators and language validators. The subject matter validators assessed several indicators: alignment with essential competencies and indicators, accuracy, learning support, and presentation techniques. Language validators assessed language accuracy, including using EYD correctly (spelling and grammar) in nine statements. Validation was carried out using a five-point scale: perfect (5), good (4), sufficient (3), poor (2), and not good (1). The average score was calculated to determine the validity of the test items The validity or feasibility criteria for the test instrument in this study refer to (Wulandari et al., 2020) as presented in the following Table 1.

Table 1. Validity Range and Feasibility Level

Score Range	Average Feasibility Level
4,0 - 5,0	Very Valid
3,0 - 3,9	Valid

2,0 - 2,9	Less Valid
1,0 - 1,9	NotValid

The validity data analysis is based on the evaluations provided by validators through a validation sheet. This sheet includes several statements related to the validation of content, construction, and language aspects. The assessment is carried out using a five-level scale: perfect (5), good (4), sufficient (3), less good (2), and not good (1). Afterward, the average score of all assessments is calculated to determine the validity level of the test instrument.

Table 2. HOTS Question Validation by Subject Matter Experts

No	Indicator	V1	V2	Average
1	Alignment with KD and Indicators	4,6	4,6	4,6
2	Accuracy of the Question	4,5	4,25	4,37
3	Learning Support Questions	4,75	4,75	4,75
4	Presentation Technique	4,6	4	4,3
	Average			**4,5**

Table 2 is the validation table for HOTS questions based on assessments by subject matter experts in mathematics. The table shows that the validation of the development of HOTS ethnomathematics questions based on Islamic values is divided into four indicators, as assessed by subject matter experts in mathematics. The indicators are the alignment of the questions with essential competencies and indicators, the accuracy of the questions, the supporting questions for learning, and the presentation technique. Each indicator shows a very valid average score, with scores above 4.0. The overall average score is 4.5, indicating that the questions are highly valid.

Suggestions from Validator 1 (subject matter expert) included revising the wording or the use of terms for the cognitive level or Bloom's taxonomy, suggesting that appropriate terminology be used according to Bloom's taxonomy levels. The suggestion from Validator 2 (subject matter expert) was to label the images, clarify the use of operational verbs, and ensure that the KKO (Indonesian term for Competency Standards) aligns with the indicators of the questions.

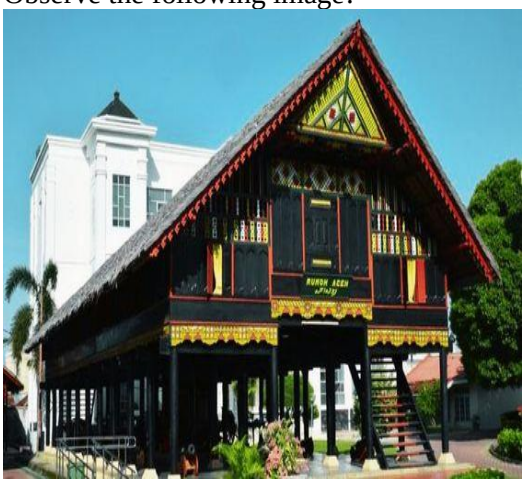
Table 3. HOTS Question Validation by Language Experts

No	Indicator	V1	V2	Average
1	Language Accuracy	4	4,1	4,05

Table 3 is the validation table for HOTS questions based on the validation from language experts. Validator 1 gave an average score of 4.0, and Validator 2 gave an average score of 4.1. The result of the average score from both validators is 4.05. This indicates that the language experts' validation is very valid, with a score above 4.0.

The suggestion provided by Validator 1, a language expert, was that the discussion on Islam-based ethnomathematics is relatively straightforward, but the language used still needs to be more effective and can have multiple interpretations. The suggestion from Validator 2 was to avoid using conjunctions at the beginning of sentences.

Table 4. Revised Development of HOTS Ethnomathematics Questions:

No	Before Revision	After Revision
1	Observe the following image!  Identify and analyze the flat shapes present in the pattern of the image. Mention the types of flat shapes you found, and explain your reasoning in identifying each one!	Observe the image of Rumoh Aceh, the traditional house of Aceh, which features various flat shapes in its roof, walls, stairs, and floor. This traditional house is built with the philosophical meaning of Acehnese life, emphasizing Islamic values, harmony, and cooperation.  Figure 1 Rumah Krong Bade (Rumoh Aceh) **1.** Identify the flat shapes on the roof, door, windows, and floor. Explain the properties of each flat shape, such as the number of sides, angles, symmetry, and relationships between the shapes. **2.** If the roof is an isosceles triangle with a base of 12 meters and a height that is half its base length, calculate its area. **3.** The walls are rectangular, with a height of 4 meters and a width of 5 meters. If there are four walls, calculate the total area of the walls. **4.** The floor is square-shaped with a side length of 8 meters. Calculate the area and perimeter of the floor. The traditional Aceh house was built based on strong principles of community cooperation. How can you apply the value of cooperation in daily life, both at school and home? Relate symmetry and balance in the design of the traditional house to the importance of maintaining

	a balance between duties and rights in life.
	5. Imagine you are tasked with designing a modern traditional house that retains the philosophy of Rumoh Aceh. Use the flat shapes you have learned. Draw a simple sketch of the house and write an explanation of the design philosophy you created.

Table 4 is a revision table of the question development based on feedback from subject matter experts and language experts. The improvements made include adding questions related to positive psychology, which involves understanding, motivation, and self-confidence. The questions consist of five items. The first through fourth questions are HOTS questions at level C3, which is application, and the fifth question is a HOTS question at level 6, which is creation, as students are asked to illustrate a design of a modern traditional house that still maintains the philosophy of Rumoh Aceh with their own version. (Haikal & Syam, 2019) The philosophy of Rumoh Aceh includes wisdom, culture, faith in Allah, etiquette, and love for what one possesses.

The researcher also distributed a questionnaire to assess students' responses to the development of HOTS ethnomathematics questions based on Islamic values. The response questionnaire was administered using Google Forms, containing seven questions with answers rated as: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1), as presented in Table 5 below.

Table 5. Questionnaire to Assess Students' Responses

No	Question
1	I understand mathematics better when linked to the Rumoh Aceh culture.
2	Learning about Rumoh Aceh motivates me to study mathematics.
3	I feel proud to be part of the Acehnese culture after learning its connection to math.
4	The questions make me think more critically.
5	I enjoy learning mathematics when using the context of Rumoh Aceh.
6	This learning is relevant to my daily life.
7	I feel more confident in solving math problems after learning about Rumoh Aceh.

The results of the seven questions in Table 3 regarding students' responses to the development of HOTS ethnomathematics questions are illustrated in the chart below:

Figure 1. Question 1

Most students responded positively, agreeing that they understood mathematical concepts better when the developed questions were related to Rumoh Aceh, with 67.5% agreeing.

Twenty-seven point five percent provided neutral responses, while only a few students strongly agreed. This indicates that most students can grasp mathematical concepts more effectively through the context of Rumoh Aceh.

Figure 2. Question 2

Seventy-two point five percent of students responded positively to the statement that learning in the context of Rumoh Aceh motivates them to study mathematics. Twelve percent strongly agreed, 10% were neutral, and some students disagreed, stating that the development of these questions did not motivate them to learn.

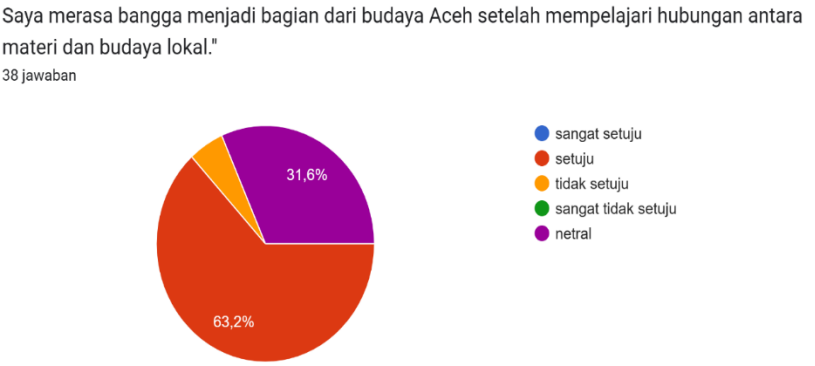


Figure 3. Question 3

Students feel proud to be part of the Acehnese culture because they have learned the connection between geometry concepts and the culture, with 63.2% in agreement. Thirty-one point six percent expressed a neutral response, while 5.3% disagreed.

Figure 4. Question 4

Sixty-two point five percent of students feel that working on the HOTS questions helps them think more critically. Fifteen percent expressed a neutral opinion, 10% strongly agreed, and 12.5% disagreed.

Figure 5. Question 5

Seventy-two point five percent of students enjoy learning mathematics using the cultural context of Rumoh Aceh. Twenty-two percent expressed a neutral opinion, and 7.5% strongly agreed. Most students feel that they enjoy learning mathematics using the cultural context of Rumoh Aceh.

Figure 6. Question 6

Students feel that learning through HOTS ethnomathematics questions is relevant to their daily lives, with 57.5% agreeing. Thirty percent provided neutral responses. The remaining students strongly agreed, accounting for 7.5%, while 5% expressed disagreement.

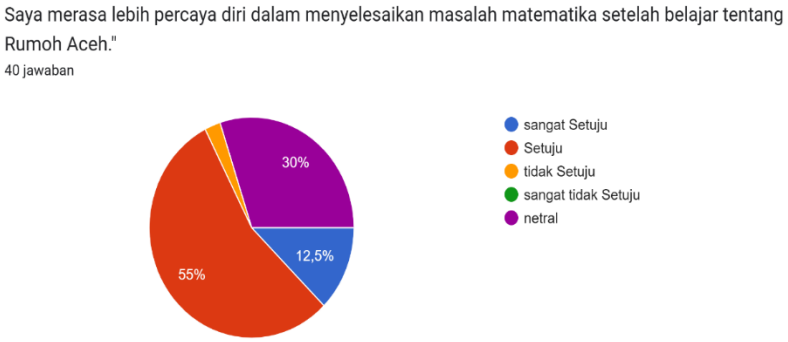


Figure 7 .Question 7

Students feel more confident solving math problems after learning about Rumoh Aceh, with 55% agreeing. 30% expressed a neutral opinion, while 12.5% strongly agreed, and only a small percentage, 2.5% (one student), disagreed. Interview results indicate that students faced the most significant challenge when working on the HOTS ethnomathematics question development related to drawing the Rumoh Aceh. Students were asked to design a modern traditional house that still retains the philosophy of the Rumoh Aceh. They were tasked with drawing or recreating a modern house design based on the geometric shapes they had learned or studied.

CONCLUSION

This research results in a HOTS-based ethnomathematics question product that is valid and integrates Islamic values to enhance students' positive psychology. The questions focus on understanding concepts deeply, processing, and using information in problem-solving contexts. This approach fosters critical thinking and increases students' confidence in mathematics. The findings suggest that linking mathematics to local culture, such as the Rumoh Aceh, motivates students, fosters critical thinking, and in stills a sense of pride in their cultural heritage.

Developing these HOTS-based ethnomathematics questions is beneficial for promoting meaningful learning, encouraging positive psychological outcomes, and enhancing students' mathematical thinking. Further development and refinement of such instruments are encouraged for broader educational use.

ACKNOWLEDGMENTS

The researcher thanks the supervising lecturers for their guidance, feedback, and valuable support throughout this study, especially in the design of the HOTS-based ethnomathematics questions with Islamic values.

AUTHOR CONTRIBUTIONS

SL designed the HOTS-based ethnomathematics questions with Islamic values, conducted the research, and wrote the research article. AR provided feedback on the design of the questions and contributed to the literature review on positive psychology.

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